REMARKS

Claims 1, 16, and 31 have been amended. Claim 35 has been canceled. Claims 1-3, 6-14, 16, 18, 21-29, 31, and 36-45 are now pending. Applicants reserve the right to pursue the original claims and other claims in this and other applications. Applicants respectfully request reconsideration of the above-referenced application in light of the amendments and following remarks.

Claims 1-3, 6-16, 18, 21-31, and 34-45 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,376,309 ("Wang") in view of Hoff or Ruzyllo. The rejection is respectfully traversed.

The Office Action acknowledges that Wang fails to show forming the second oxide layer using an oxidizing ambient in atomic oxygen to form the oxide layer with a thickness of 60% of a targeted thickness and at various temperatures and times (pg. 3). The Office Action relies upon Hoff or Ruzyllo for disclosing an oxidizing ambient using atomic oxygen since the processes in Hoff and Ruzyllo allow for oxide growth at low temperatures.

Applicants respectfully submit, however, the cited references do not disclose or suggest the subject matter of claims 1, 16, and 31 for at least the following reasons. First, the cited references do not teach or suggest forming a "second oxide layer is formed to have a thickness of at least 60% of the targeted thickness of the second oxide layer," as recited in claim 1, "growing a second oxide layer . . . at a temperature of about 850°C to about 1100°C, for about 1 second to about 10 minutes, using a gas ambient containing atomic oxygen, wherein said second oxide layer is formed to have a thickness of at least 60% of the targeted thickness of the second oxide layer," as recited in claim 16, or growing a second oxide layer "in the presence of atomic oxygen at a temperature of less than about 900°C for a period of about 1 second to 10 minutes, and

wherein said second oxide layer is formed to at least about 60% of a targeted thickness of said second oxide layer," as recited in claim 31.

Second, there is no motivation to combine the cited references. Moreover, even if the references are combinable, which they are not, Wang would undergo a major redesign and reconstruction to accommodate Hoff or Ruzyllo's oxidation process with atomic oxygen.Third, that the motivation to combine only seems obvious in light of Applicants' specification. Finally, the Office Action has not set forth a *prima facie* case of obviousness.

The Office Action asserts that with respect to the particular time and temperature of the oxidation, it would have been obvious to determine through routine experimentation the optimum time and temperature to conduct the oxidation process based upon a variety of factors including the desired thermal budget and would not lend patentability to the instant application absent the showing of unexpected results (pg. 3). Applicants respectfully submit that the claimed process employs particular times and temperatures that results in a second oxide layer formed to at least 60% of a targeted thickness of the second oxide layer, which is an unexpected result obtained through the use of atomic oxygen at the claimed temperatures and times.

For example, Applicants' specification discloses that a conventional ONO interpoly dielectric layer is typically formed by a high temperature, wet oxidation process (Applicants' specification, pg. 6, lines 13-15). This process would include "oxidizing the nitride layer in steam and oxygen at a high temperature of about 950°C, for a long duration of time, typically about 2 hours." (Applicants' specification, pg. 6, lines 15-17). The "lengthy oxidation process is necessary because the actual thickness that is deposited is <u>only about 1%</u> of the targeted thickness." (Applicants' specification, pg. 6, lines 17-19).

In Wang, "the second of the two oxide layers of the dielectric layer 410 is formed using a nitride oxidation technique at about 950°C." (Col. 3, lines 50-51). Wang discloses a targeted thickness of 50 Å for the top oxide layer. However, Wang discloses a conventional wet oxidation process for forming the top oxide layer. As a result, the actual thickness of Wang's top oxide layer would only be about 1% of the targeted thickness. Applicants' claimed method, in contrast, "provides a top oxide layer, having a resulting thickness of at least about 60% of a targeted thickness of the top oxide layer on the nitride layer, as compared to a typical resulting thickness of about 1% of the targeted thickness of the top oxide layer in conventional methods, such as wet oxidation, not utilizing atomic oxygen." (Applicants' specification, pg. 7, lines 13-18). The cited references do not teach or suggest forming a top oxide layer with a resulting thickness of at least about 60% of a targeted thickness. Accordingly, the cited references do not teach or suggest the subject matter of claims 1, 16, and 31.

As the Examiner acknowledges, Wang does not teach or suggest using atomic oxygen to form a top oxide layer. The Office Action asserts that because Hoff and Ruzyllo disclose the use of atomic oxygen, which lowers the temperature requirements in forming an oxide layer, i.e., lowers the thermal budget, proper motivation has been provided and Wang would employ the teachings of Hoff or Ruzyllo. Applicants respectfully disagree. There is no motivation to combine the cited references.

Wang is directed to a method of <u>reducing</u> the gate aspect ratio of a flash memory device (Abstract). To this end, Wang discloses replacing the conventional tungsten silicide in a control gate layer with nickel silicide (Abstract). Although Wang may disclose the formation of a dielectric layer 410 comprising an oxide-nitride-oxide layer; the dielectric layer 410 is <u>conventionally</u> formed. In particular, the top oxide layer is formed at a temperature of 950°C.

Hoff discloses the results of thermal oxidation of silicon in a flowing atomic oxygen afterglow process (¶2). The oxidation system used in the experiment (FIG. 1) was a standard thermal oxidation system with a microwave atom source and vacuum pumping ability (¶3). Hoff concludes that in a vacuum process, "thin films in the thickness range needed for gate oxides in high density metal-oxide-semiconductor circuits may be grown at half the temperature of conventional oxidation." (pg. 2, ¶4). Hoff does not teach a method of forming a second oxide layer to have a thickness of at least 60% of the targeted thickness. Hoff merely suggests that atomic oxygen can be used to decrease the temperatures required for conventional oxidation, if desired.

Ruzyllo is directed to studying the basic electrical properties of films of silicon dioxide grown on silicon by a microwave plasma atomic oxygen afterflow method (Summary). Ruzyllo concludes that the method of remote plasma oxidation of silicon allows gate oxides to be grown at temperatures as low as 400°C (Summary). Similar to Hoff, however, Ruzyllo does not teach a method of forming a second oxide layer to have a thickness of at least 60% of the targeted thickness. Ruzyllo merely suggests that atomic oxygen can be used for oxidation temperatures as low as 400°C.

However, employing atomic oxygen, in Wang, would increase the gate aspect ratio. In Hoff, films that were grown in the afterglow method at a high temperature, were overall thicker than those grown in the thermal mode alone (pg. 2, ¶2). The idea of forming a thicker ONO structure is contrary to the problem that Wang is directed to solving: reducing the gate aspect ratio of a flash memory device. A thicker ONO structure would increase the gate aspect ratio. An atomic oxygen process would not be desirable in Wang. Accordingly, one skilled in the art would not be motivated to combine an atomic oxygen process with Wang's methods since it would increase the gate aspect ratio rather than decrease it.

Moreover, even if the references could somehow be combined, despite any motivation to do so, it is well-settled that "[t]he mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination." M.P.E.P. § 2143.01 (emphasis added). The prior art is not suggesting the proposed combination; but, rather the claimed invention is the foundation for the combination. Applicants discovered that atomic oxygen, can yield a top oxide layer that is 60% of the targeted thickness. The proposed combination is improper hindsight reconstruction.

Further still, it is not proper to combine references where doing so "would require a substantial reconstruction and redesign of the elements shown in the primary reference [i.e., Wang] as well as a change in the basic principle under which the primary reference [i.e., Wang] construction was designed to operate." In re Ratti, 270 F.2d 810, 813, 123 U.S.P.Q. 349, 352 (C.C.P.A. 1959). This is well-settled Office policy. See M.P.E.P. § 2143.01, page 2100-127 (Feb. 2003).

The 'modification' proposed by the Examiner, in the rejection of claims 1-3, 6-16, 18, 21-31, and 34-45, requires a substantial reconstruction and redesign of Wang's elements, and changes the basic principle under which Wang was designed to operate. As indicated previously, Wang is directed to reducing the gate aspect ratio by substituting nickel silicide for tungsten silicide. In forming the dielectric layer, Wang merely discloses a conventionally formed ONO structure at a temperature of 950°C for a period of 40 minutes. If the references could be combined, Wang would yield a thicker ONO structure formed at a temperature of around 950°C for forty minutes, which would increase the gate aspect ratio since Hoff discloses a thicker oxide layer is formed at higher temperatures with atomic oxygen. The entire premise of Wang would be defeated. Wang would have to undergo a substantial reconstruction and redesign to accommodate for the increased thickness of the dielectric layer, which increases the

overall gate aspect ratio.

"A statement that modifications of the prior art to meet the claimed invention would have been 'well within the ordinary skill of the art' at the time the claimed invention was made because the references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a *prima facie* case of obviousness without some objective reason to combine the teachings of the references." M.P.E.P. § 2143.02. There is no objective reasoning to combine Wang with Hoff or Ruzyllo where the proposed combination would increase the gate aspect ratio in Wang.

Moreover, even if the references are combined, they still would not teach the subject matter of claims 1, 16, and 31. As indicated above, the proposed combination would result in Wang's top oxide layer formed in atomic oxygen at a temperature of 950°C, for a period of 40 minutes. The cited references do not teach or suggest forming a top oxide layer to at least 60% of the targeted thickness, as recited in claims 1, 16, and 31. The cited references would not teach or suggest forming a top oxide layer in atomic oxygen for about 1 second to about 10 minutes, as recited in claims 16 and 31. Wang discloses a time of at least 40 minutes which is four times longer than Applicants' claimed process. The cited references would not teach or suggest forming a top oxide layer in the presence of atomic oxygen at a temperature of less than about 900°C, as recited in claim 31.

As such, the cited references do not disclose or suggest a method of forming a flash memory cell by "forming an insulating layer comprising a first oxide layer . . . a nitride layer . . . a second oxide layer . . . said second oxide layer grown by oxidizing said nitride layer with a gas ambient containing atomic oxygen, wherein said second oxide layer is formed to have a thickness of at least 60% of the targeted thickness of the

second oxide layer," as recited in claim 1.

The cited references do not disclose or suggest a method of forming an ONO insulating structure by "growing a second oxide layer . . . at a temperature of about 850°C to about 1100°C, for about 1 to about 10 minutes, using a gas ambient containing atomic oxygen, wherein said second oxide layer is formed to have a thickness of at least 60% of the targeted thickness of the second oxide layer," as recited in claim 16.

Similarly, the cited references do not disclose or suggest a method of forming a flash memory array containing a plurality of flash memory cells, each of said plurality of flash memory cells being formed by the acts of "forming an insulating layer comprising a first oxide layer . . . a nitride layer . . . a second oxide layer . . . wherein said second oxide layer is grown in the presence of atomic oxygen at a temperature of less than about 900°C for a period of about 1 second to 10 minutes, and wherein said second oxide layer is formed to at least about 60% of a targeted thickness of said second oxide layer," as recited in claim 31.

Claims 2-3 and 6-15 depend from claim 1, claims 18 and 21-30 depend from claim 16, and claims 36-45 depend from claim 31. These claims should be allowable for at least the reasons set forth above regarding independent claims 1, 16, and 31, and on their own merits.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

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Respectfully submitted,

By

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